SAMPLING AND ANALYSIS PLAN
FOR TESTING OF SEDIMENTS
FOR MAINTENANCE DREDGING AT THE
LEVIN-RICHMOND TERMINAL CORPORATION
RICHMOND, CALIFORNIA

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Advanced
Biological
Testing Inc.

# SAMPLING AND ANALYSIS PLAN FOR TESTING OF SEDIMENTS FOR MAINTENANCE DREDGING AT THE LEVIN-RICHMOND TERMINAL CORPORATION RICHMOND, CALIFORNIA

#### Prepared for:

Levin-Richmond Terminal Corporation 402 Wright Ave. Richmond, CA 94804

Prepared by:

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#### INTRODUCTION

#### 1.1 OVERVIEW

confusing.

The Levin Richmond Terminal is proposing to conduct a maintenance dredging program at Berths A and B at its loading terminal in the Port of Richmond (Figure 1). The currently permitted depth at the Berth is -39 feet MLLW. (Permit #21358S-43). As seen in Figure 2, the Berth A is on the Santa Fe Channel east of the Lauritzen Canal will be dredged to -39 feet MLLW. Currently, the depth in the site ranges from -34 to -40 feet MLLW. A two foot overdredge allowance is requested with the site being sampled and tested to -41 feet MLLW. The total estimated volume of sediment material is approximately 5311 cubic yards and includes the 2' overdredge.

Berth B is on the Lauritzen Canal at the confluence of the Santa Fe Channel and the Lauritzen Canal and is proposed to be dredged to -37 feet MLLW. Currently, the depth in the site ranges from -34 to -40 feet MLLW. A two foot overdredge allowance is requested with the site being sampled and tested to -39 feet MLLW. The total estimated volume of sediment material at Site B is approximately 18.000 cubic yards and includes the 2' overdredge. It is proposed that the dredge material will be disposed at the Alcatraz Disposal Site (SF-11) located in central San Francisco Bay.

This document is intended to support the application for regulatory permits including a Department of the Army permit to conduct this dredging at the site and dispose of the dredged material in the designated dump site. The specific purpose of this document is to seek regulatory agency approval of a Sampling and Analysis Plan for sediment analysis and dredge material bioassays.

#### 1.2 ADJACENT WATER/LAND USES AND RECENT TESTING HISTORY

#### 1.2.1 Water and Adjacent Land Uses

Water Uses: These berths are primarily dry material loading and storage terminals and provided loading facilities for commercial shipping. There have been no petroleum spills at this berth in the past 10 year. Berth A is along the Santa Fe Canal, south east of the

Lauritzen Canal. It receives moderate levels of tidal action and the berth has not been dredged since 1995-1996

Berth B is oriented inside the confluence of the Santa Fe Channel and the Lauritzen Canal, and has not been dredged since 1995-1996.

A portion of Lauritzen Canal was designated as a Superfund site with high levels of PCBs and pesticides being generated by a chemical manufacturing plant at the head of the channel. The EPA and others required a cleanup action which has occurred with most contaminated material being sent offsite to a Class 1 landfill. A sand cap was placed over much of the sediments that were left in place within the channel.

Adjacent Land Uses: These berth is near the northern end of the main Harbor Channel. It is in the center of the Port of Richmond and is surrounded by marine terminals and upland associated marine facilities. The primary source of runoff from this berth is surface flow from storms, and some solid material that may be accidentally dropped during loading or unloading. No significant storm drains are located in the project area

#### 1.2.2 Recent Testing History

The most recent work at the berth was during the Corps sponsored dredging of the main channel in the Port of Richmond. The work was done in 1995-1996 under ACOE Permit # 21358S-43. While the data is likely available from the Corps, no data has been provided to ABT for review.

| Mould Supply to DMMO|

#### 1.3 QUANTITY CALCULATIONS

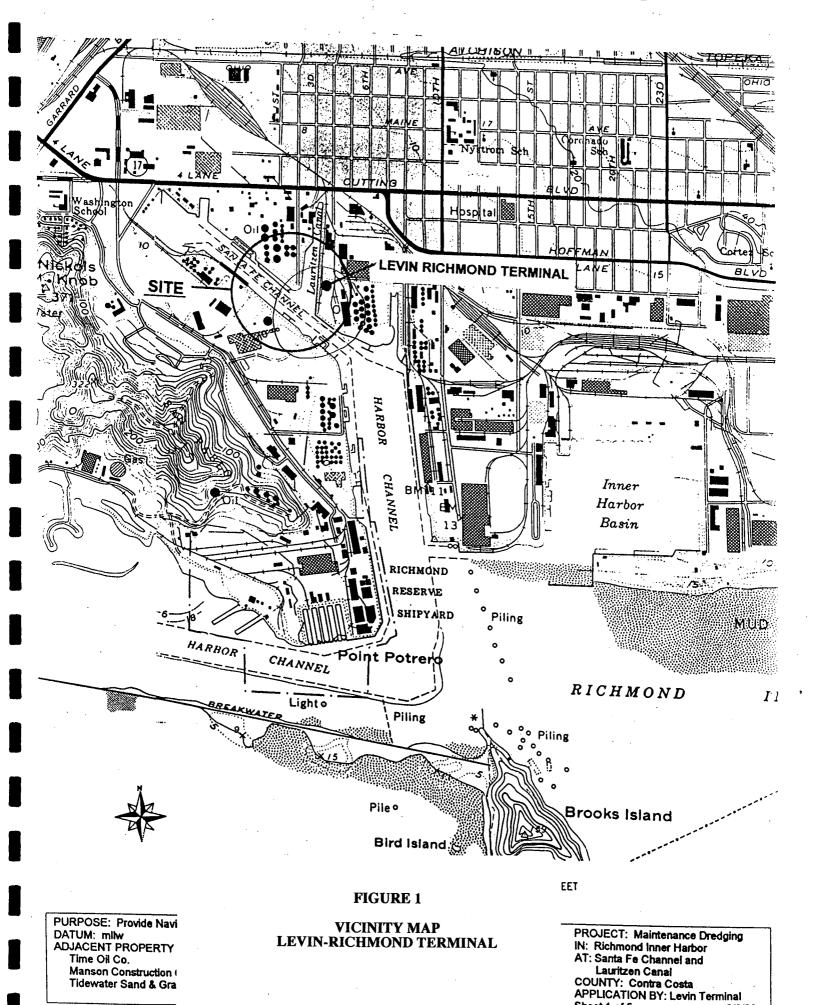
The quantities of sediment from the proposed dredge areas were calculated based upon the proposed dredge depth and includes the overdredge amount. They are calculated from soundings taken in June, 1999 (Figure 2).

#### **Volume Calculations**

Area	Ave. Depth	Volume (cu yds)	No. of cores	Vol/Core (yds)
	- -			
Berth A	-35.2	5,311	4	1.327
Berth B	-34.8	18,000	4	4.500

#### 1.4 ORGANIZATION

This proposal follows guidelines provided in the Testing Manual for the Evaluation of Dredged Material discharged in waters of the U.S. (U.S.EPA/ACOE, 1998). It provides details of the proposed scope of work, proposed sampling locations, a table of target analytes, and appropriate references.

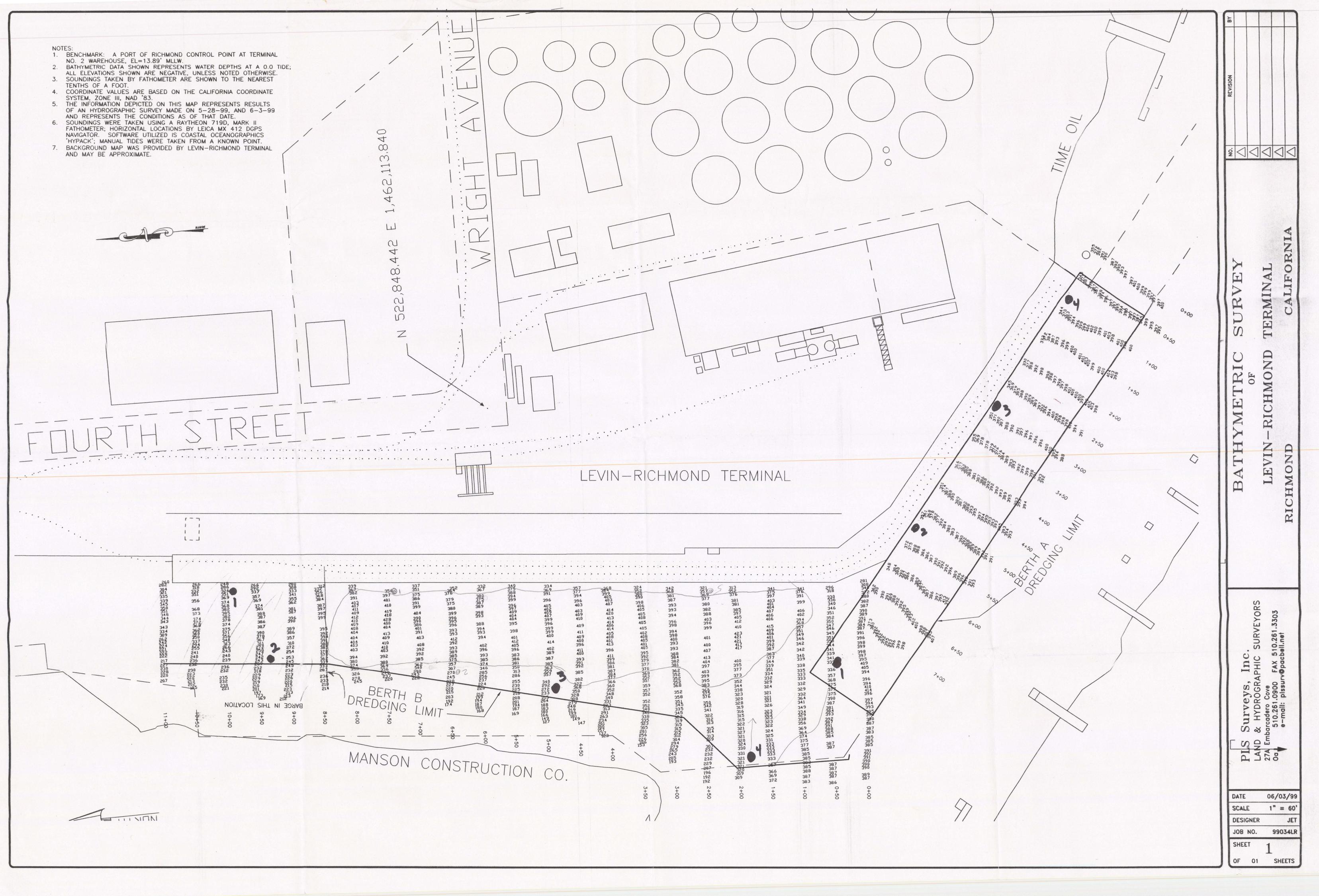


Sheet 1 of 5

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#### FIGURE 2

PROJECT SITE LEVIN-RICHMOND TERMINAL CORPORATION



#### PROPOSED SCOPE OF WORK

#### 2.1 SCOPE OF WORK

The following scope of work is proposed regarding a Tier 3 level testing of sediments from the Levin Terminal in the Port of Richmond. Testing requirements are based the Inland Testing Manual (ACOE/U.S.EPA 1998).

The project management, bioassay testing, and grain size analysis will be carried out by:

Advanced Biological Testing Inc. 5685 Redwood Dr. #105 Rohnert Park, California 94928 Contact: Dr. Kurt F. Kline (707-588-2880)

The analytical chemistry will be carried out by:

CRG Marine Laboratory 820 S. Seaside Avenue Terminal Island, California 90731 Contact: Mr. Rich Gossett (310-519-4007)

#### 2.2 SEDIMENT COLLECTION

It is proposed that the Levin Richmond Oil Terminal (Berths A and B) be tested as a two site program based upon the requirements in ITM and the projected volume to be removed (approximately 23,000 cubic yards).

Sample stations: Both of the Berth areas will be sampled with four stations in each area. All of the test stations at the site are placed to provide an overall assessment of the sediment quality. The four stations making each composite are the minimum number per site (ITM). In the event problems are found in the site composite, the individual cores can be analyzed. Contamination problems can then be defined proportional to the sampling stations.

Positioning will be by differential GPS as well as visually off the shoreline using a range-By bout? finder.

Each core sample in Berth A will be taken to the depth of -41 feet MLLW which includes the 2 foot overdredge depth. Sampling will be by gravity or pushcorer. Refusal depth will be noted. All station locations will be provided in the final report.

Each core sample in Berth B will be taken to the depth of -39 feet MLLW which includes the 2 foot overdredge depth. Sampling will be by gravity or pushcorer. Refusal depth will be noted. All station locations will be provided in the final report.

Each collected core will be placed in a food-grade plastic bag: labeled and placed in coolers and returned to the laboratory. Each composite will be made from the four stations taken in that area, for bioassay testing, and chemical and physical analyses. All composites will be made proportional to the volume of sediment collected in each sample. A sample will be retained for archival from a thoroughly homogenized composite of each station core. All archived samples will be stored at 4°C until used. Chain of custody forms will be prepared in the field as the samples are collected and will follow the individual sample numbers through the testing process.

The Alcatraz Environs Reference sample will be a composite of individual samples taken at each of the eight locations defined in PN-93-2. Coordinates are in Note 1. The samples will be collected by ABT personnel supported by J. Brezina and Associates using the R/V Winner. If one or more stations cannot be collected, it will be noted in the report. The station samples will be immediately composited onboard the sampling vessel and placed in a cooler. Individual station sediments from the Alcatraz Environs will not be retained unless specifically requested by the DMMO. Chain of custody documents will be initiated in the field.

Control sediments appropriate for the amphipod and polychaete test species will be used to provide the sediment controls for the bioassays. The control location for the test species and sediment will be included in the final report. Chain of custody documents will be initiated upon delivery to the laboratory.

#### 2.3 CHEMICAL ANALYSIS OF SEDIMENTS

Full bulk sediment chemistry will be carried out on each composite sample. All of the sediment analyses will be presented in dry weight either as mg/kg or as  $\mu$ g/kg as appropriate. Analyses shown in Table 1 will include:

- (1) Priority pollutant metals using an Inductively Coupled Plasma Mass Spectrometer (ICP/MS) according to EPA Method 6020.
- (2) Semi-volatile organics including PAHs, Chlorinated Pesticides, and PCBs will be extracted using EPA Method 3545 and cleaned up using EPA Methods 3611 and 3630 (Alumina/Silica Gel).
- (3) Polynuclear Aromatic Hydrocarbons (PAHs) will be performed using a Capillary Gas Chromatograph Mass Spectrometer (GC/MS) according to EPA Method 8270C.
- (4) Chlorinated Pesticides including 2,4'-DDT, 2,4'-DDE, and 2.4'-DDD by Capillary Gas Chromatography will be performed using EPA Method 8081A.
- (5) PCBs by Capillary Gas Chromatography will be performed using EPA Method 8082.
- (6) Dissolved sulfides will be analyzed using SM4500.
- (7) The analysis of organic tin will be performed following the method described in Rice (1987). Briefly, this method involves the solvent extraction of samples followed by derivitization using excess Hexamethyl Magnesium Bromide. The precipitate is dissolved using HCl and the solvent layer is removed and passed through an Alumina/Silica Gel column. Samples are then analyzed using a Capillary Gas Chromatograph Mass Spectrometer (GCMS) in the selected ion monitoring (SIM) mode.

#### 2.4 PHYSICAL ANALYSES OF SEDIMENTS

The composite will be characterized for physical properties. Physical analyses of the dredge material are performed using the methods described in Plumb (1981) and include:

(1) Grain Size (without the peroxide treatment) by combining the dry sieve and the

hydrometer methods to analyze the smaller particle sizes expected at these sites. The frequency distribution of the size ranges (reported in millimeters) of the sediments will be presented in the report and will be summarized as the percentage of sand, silt, and clay fractions, (2) Total Organic Carbon (TOC) is determined by combustion using an Elemental Analyzer, (3) Total Solids are determined by drying the sample to a constant weight at 103-105°C.

#### 2.5 **BIOLOGICAL TESTING**

embryo? The composite samples will be tested using bioassay tests designated by the ITM. These tests include the water column analysis using bivalve/larvae or echinoderm larvae and benthic analysis using an amphipod species and a marine polychaete. All test sediments are run for interstitial ammonia, dissolved sulfides, pH and salinity. The ammonia measurement will be done using centrifuged interstitial water and a specific ion electrode: dissolved sulfides are analyzed using colorimetric analysis: pH is measured in the interstitial water by hand-held pH meter; and the salinity of the interstitial water done by conductivity meter (salinity mode).

Any appropriate adjustment of the sediments required will be documented. For ammonia. concentrations in interstitial water can be reduced by sufficiently aerating the sample and replacing two volumes of water per day. The interstitial ammonia concentrations will be determined daily until the concentrations are below 15 mg/L. The process of handling sediments by screening them through 1 mm screens generally reduces the dissolved sulfides as H<sub>2</sub>S gas. Salinity is not generally a problem in marine or estuarine sediments (San Francisco Bay). However if sediments are taken from above the Carquinez Strait or from other areas that are exposed to high freshwater flows, the interstitial salinity may be low enough to cause testing problems. Marine polychaetes will be the group of test organisms most affected by the interstitial salinity. Salinity can be adjusted by adding 3-4 volumes of normal strength seawater (32-34 ppt) to the sediments in a large chamber and mixing them gently but thoroughly by hand. The sediments are then placed in the test chambers and the study initiated. The role of pH is much more difficult to deal with since sediments can range from acidic to quite basic and still demonstrate no significant toxicity. There are no specific guidelines for controlling pH levels in sediments.

No bioaccumulation testing is being proposed at the present time. However if significant concerns are raised from results of the chemical analyses, the specific site(s) will be resampled and tested for bioaccumulation if requested. An amended SAP which will include the appropriate test species, testing conditions and the list of analytes will be prepared for approval by the DMMO prior to test initiation.

#### 2.5.1 ELUTRIATE PREPARATION

The elutriate test will be performed according to U.S.EPA/ACOE (1998), using an initial 4:1 dilution of dredge site seawater to test sediment. If the salinity of the dredge site water is outside the acceptable range for the test species, the regulatory agencies will be called for advice. The mixture will be blended thoroughly for thirty minutes and then allowed to settle for one hour at room temperature (16°-18°C). The supernatant, identified as the 100% elutriate, will be siphoned off for use in the bioassay. Dilution of the 100% elutriate will be with natural seawater from Bodega Marine Laboratory. Normal water quality measurements will be taken including: ammonia, salinity, temperature and pH as specified in the guidelines.

#### 2.5.2 ELUTRIATE TESTING

The elutriate bioassay tests will be performed using the bivalve or echinoid larvae bioassay test at 1, 10, 50, and 100 percent levels against a natural seawater control under static conditions using as appropriate any of the following species: Mytilus edulis. Crassostrea gigs, or the urchins Strongylocentrotus purparatus or Lytechinus pictus (Tables 2 and 3). The test methods (ASTM, 1998a or 1998d) will be run for 48-96 hours for development of the larvae to the end stage defined in the ITM and ASTM documents. Due to the low reproductive effort in oysters this summer, it is likely that ABT will use the sea urchin for the water column test. Urchins can normally be spawned during most of the year since they are induced to spawn using potassium chloride

The endpoints of percent survival, mortality and the percentage of abnormal development will be presented. A copper sulfate reference toxicant will be run concurrently.

#### 2.5.3 BENTHIC TESTING

An amphipod benthic bioassay will be run using ASTM (1998b) methods (Table 4). It is proposed that the selected amphipod species from the approved list is *Ampelisca abdita*. The survival in the test sediments will be compared to the results observed in the reference sediment using statistical comparison and the <20% difference rule currently being used in the testing guidelines. A determination of significant toxicity would be based upon these results.

A 10 day benthic bioassay will be run using marine polychaetes according to methods of ASTM (1998c) for the polychaete bioassay (Table 5). It is proposed that the selected polychaete species is *Nephtys caecoides* which will be stocked in the test chambers at 10 animals per chamber. The survival in the test sediments will be compared to the results observed in the reference sediment using statistical comparison and the  $\leq$ 10% difference rule currently being used in the testing guidelines. A determination of significant toxicity will be based upon these results. Porewater ammonia will be analyzed at project initiation and on Day 10 in a single replicate.

A reference toxicant test will be run concurrent with the sediment testing and will be a 96 hour static bioassay for the amphipod and a 24 hour static test for the polychaete. using sodium dodecyl sulfonate (SDS) as the standard reference toxicant. The concentrations are presented in Section 2.6.2. This reference data will be compared to inhouse data to determine if the sensitivity of the test organism was appropriate for the test.

# 2.6 QUALITY ASSURANCE OBJECTIVES

Quality assurance procedures to be used for sediment testing are consistent with methods described in the U.S.EPA/ACOE (1991, 1998) and U.S.EPA (1988). The methods employed in this sediment testing program are detailed in standard guides and procedures maintained in the bioassay laboratory as well as the analytical laboratory.

#### 2.6.1 Chemical Analysis Quality Assurance

QA/QC procedures will include the analysis of procedural blanks, matrix spike and matrix spike duplicates, surrogate spikes and certified reference material or a laboratory

control sample on a 10% frequency: The following QA/QC parameters will be documented:

Accuracy: Accuracy estimates will be based on either spiking of a matrix similar to the sample, a laboratory control material, or a certified reference material. Sample spikes are added prior to processing the sample and carried throughout the entire analytical procedure. Results from spikes and/or reference materials are reported in percent recovery with acceptance ranges and amount spiked or true value.

Precision: Precision will be estimated by analyzing either duplicate samples or duplicate spikes. Results from duplicate sample analyses may also indicate homogeneity of the sample matrix. Relative standard deviations (RSDs) are calculated for all duplicate samples or spikes and are reported along with acceptance ranges.

Ongoing Precision and Recovery: For Chlorinated Pesticides/PCBs and PAHs, each sample is spiked with surrogates prior to extraction of the sample and carried throughout the entire procedure. For the chlorinated hydrocarbons, the surrogates are 2,4,5.6-Tetrachloro-m-xylene, PCB congener 65, and PCB congener 209. For the PAHs, the surrogates are d8-Naphthalene, d10-Acenaphthene, d10-Phenanthrene, and d12-Perylene. The RSD and the percentage recovery for the surrogates will be reported and compared to acceptance ranges.

Methods: All sample analyses will be performed using EPA Methods, where applicable (see above for method designations for each analysis group). Daily logs of instrument performance are maintained including initial and continuing calibration verification.

All QA/QC records for the various testing programs are kept on file for review by regulatory personnel.

#### 2.6.2 Bioassay Quality Assurance

The quality assurance objectives for toxicity testing conducted by ABT involve all aspects of the testing process including:

Water and sediment sampling and handling: Sediment samples will be maintained at 4°C in the dark until they are used in the testing system. All sediments are held in sealed storage bags. Water used in the test will be from San Francisco Bay and Bodega Bay. Control survival dictates its quality. Sample chain-of-custody sheets, sample receipt logs, sample holding, and sample labeling procedures are audited weekly by the quality control unit. Sub-samples designated for long term storage are archived under the appropriate holding conditions.

Chain of Custody: Field data sheets will be used to prepare the initial chain of custody form (I-C-O-C) which defines the individual samples with specific sample numbers. When the individual samples are returned to the laboratory for compositing, a new. testing chain of custody will be prepared referencing back to the I-C-O-C. A copy of the Testing C-O-C (T-C-O-C) will be provided to the analytical laboratory as well as one being retained in the bioassay laboratory. In the event that any work is contracted to other laboratories than ABT or CRG, a separate C-O-C will be prepared for the contracted work. All C-O-C documents will be returned to ABT and will be copied into the QA appendix in the final report.

Source and condition of test organism: All test organisms will be purchased from reputable suppliers who have provided ABT with organisms in the past. Normally, all test organisms are maintained in the laboratory for acclimation (exceptions are bivalves). If mortality in excess of 5% is noted in the holding stock, the animals will be discarded and a new batch ordered.

Maintenance of test conditions and corrective actions: Each test has a set of specified test conditions as defined in the standard testing guides or other protocols. The specific parameter limits are noted in the section on the acceptability of the test. If these criteria are not met, the test will be rerun if appropriate. The test conditions and the acceptance criteria for test species are presented in Tables 2, 3, 4 and 5.

In the event that a test condition is found to be out of range, appropriate corrective actions will be taken to return the condition(s) to the acceptable test range. Some test conditions such as temperature and salinity can be easily and effectively adjusted. Adjusting pH can be more complicated. Any adjustments or corrections will be noted in the final report.

<u>Calibration procedures and frequency</u>: Instruments are calibrated daily according to Laboratory Standard Operating Procedures (SOPs) and calibration data are logged and initialed. Calibration logs are monitored weekly to ensure that they are complete.

Reference toxicant testing and data accuracy and precision: A reference toxicant will be run during the test period for each species to establish the validity of the toxicity data. Water quality measurements will be monitored to ensure they fall within the prescribed limits for each test procedure. The species, proposed reference toxicant, test duration (hours), and test concentrations are:

<b>Species</b>	Toxicant	Time	Concentrations	
Bivalve embryo	Copper sulfate	48	3.75, 7.5, 15, 30, 60 µg/L	
Echinoid embryo	Copper sulfate	96	3.75, 7.5, 15, 30, 60 µg/L	
<u>Ampelisca</u>	Sodium dodecyl sulfonate	96	1.9, 3.25, 7.5, 15, 30 mg/L	
Nephtys	Sodium dodecyl sulfonate	24	6.25, 12.5, 25, 50, 100 mg/L	

The precision of the LC50 is not normally measured in biological testing since no duplicate reference toxicant analyses are performed. Acceptable accuracy is defined as a calculated LC50 reference toxicant value that is within two standard deviations of the current laboratory mean. A value greater than two standard deviations but less than three could be acceptable if the results of the sediment testing indicate that no significant sensitivity (or lack of sensitivity) was apparent in the testing. The continued use of echinoid embryos in bioassay testing will provide a laboratory data base over time. If the echinoids are used, the reference toxicant data will be presented for informational purposes only until sufficient data (10-15 data points) are available to create a valid mean concentration.

At the present time, based upon our laboratory cumulative summaries for reference toxicants, the selected species have the following average LC50 and 2 standard deviation limits:

Species	Laboratory Mean	<b>Toxicant</b>	
Bivalve embryo	$6.3 \pm 5.88 \mu\text{g/L}$	copper sulfate	
Echinoid embryo	Database in development	copper sulfate	
<u>Ampelisca</u>	$12.4 \pm 7.34 \text{ mg/L}$	SDS	
<u>Nephtys</u>	$16.9 \pm 2.76 \text{ mg/L}$	SDS	

<u>Data Evaluations</u>: Bioassay tests are performed according to protocols and standard test conditions. The quality control unit at the laboratory checks all the raw data and records of the study to ensure that the required test conditions were within specifications. These test conditions and acceptability criteria are presented in Tables 2, 3, 4 and 5. Unforeseen circumstances that may affect the integrity of the study are reported with the test results. The data analysis and final report will be reviewed for accuracy by the quality control unit.

Deviations from the standard testing guides are reported with the final report. If any test parameter deviates from protocol, the test will be evaluated to determine whether it is valid according to the regulatory agency to which it will be submitted. If it is determined to be invalid, the client will be notified and the test rerun.

Internal quality control checks: The quality control officer conducts periodic audits to ensure that test conditions, data collection, and test procedures follow protocol. Animal receipt and maintenance log books are used to record the source and health of organisms. Reference toxicant tests serve as an internal check on organisms health and performance during the test.

<u>Sample storage and tracking</u>: Sample chain-of-custody sheets, sample receipt logs, sample holding, and sample labeling procedures are audited weekly by the quality control unit. Sub-samples designated for long term storage are archived under the appropriate holding conditions.

Data analysis, validation and reporting: All bioassay tests are performed according to protocols and standard test conditions. A summary of test conditions and acceptability criteria are shown in Tables 2, 3, 4 and 5. The quality control unit checks all the raw data and records of the study to ensure that the required test conditions are within specifications. Any unforeseen circumstances that may affect the integrity of the study are reported with the test results. The data analysis and final report are reviewed for accuracy by the quality control unit.

<u>Procedures used to assess data acceptability</u>: Acceptable accuracy will be a mean reference toxicant value that is within two standard deviations of the current laboratory mean. A value greater than two standard deviations but less than three may be acceptable if the results of the sediment testing indicate that no significant sensitivity (or lack of sensitivity) was apparent in the testing. If the value is greater than three standard deviations, the test will be rerun.

#### 2.7 STATISTICAL METHODS

At the conclusion of the elutriate tests and reference toxicant analyses, all concentration response data are evaluated statistically to estimate LC50 and EC50 values. The LC50 and EC50 values are estimated using the Probit or the Linear Interpolation (Bootstrap). Method (ITM 1998, Appendix D). The NOEC and LOEC will be identified for the elutriate tests and will be analyzed using the multiple t-test.

At the conclusion of the benthic tests, organism survival in the test sediments is compared to the appropriate reference site (SF-11 Environs). The control survival acceptability criteria for all of the benthic species is ≥90%. The statistical tests and assumptions analysis include an initial test for homogeneity of variances (F-test), followed by parametric analysis using the Student's t-test or non-parametric analysis as appropriate. A significant effect in the sediment bioassays is defined as a statistically significant difference (P≥0.05, one-tailed t-test) between the average survival in the reference and test. Rejection criteria for the solid phase tests is statistical significance and a differential of 20% for amphipods or 10% for polychaetes.

#### 2.8 REPORT

The project report will consist of a discussion of field and laboratory methods, a summary of the results of the testing programs, a log of individual cores, summary tables of sediment chemistry and the bioassay results. Complete statistical analyses will be carried out and the results reported. Complete mortality and water quality tables, the analytical reports for the sediment chemistry and physical analysis, and the quality control and assurance data for the chemical and biological analysis are presented in appendices including all C-O-C documents. The full report will be prepared for submittal to the Dredge Material Management Office of the San Francisco District Corps of Engineers for review.

TABLE 1

TARGET DETECTION LIMITS
(as Dry Weight)

Constituent	Method	Sediment
Metals (mg/kg)		
Arsenic (As)	6020	0.1
Cadmium (Cd)	6020	0.1
Chromium (Cr)	6020	0.1
Copper (Cu)	6020	0.1
Lead (Pb)	6020	0.1
Mercury (Hg)	6020	0.02
Nickel (Ni)	6020	0.1
Selenium (Se)	6020	0.1
Silver (Ag)	6020	0.1
Zinc (Zn)	6020	1.0
<u>Pesticides</u> (μg/kg)	8081A	
2, 4' - DDD	000174	,
2, 4' - DDE		<del>-</del>
2, 4' - DDT		_
4, 4' - DDD		- n
4, 4' - DDE		-
4, 4' - DDT	,	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
Total DDT		<del>-</del>
Aldrin		n
alpha-BHC		. 2
beta BHC		
Chlordane		2
delta BHC		2
Dieldrin		2
Endosulfan I		<u>2</u>
Endosulfan II		2
Endosulfan Sulfate		2
Endrin	•	2
Endrin Aldehyde		2
Heptachlor		2
Heptachlor Epoxide		2
gamma-BHC		2
Toxaphene		20
PCBs (μg/kg)	8082	
PCB 1016	0002	20
PCB 1221	•	20
PCB 1221 PCB 1232		20
PCB 1242		2() .
PCB 1242 PCB 1248		2()
PCB 1254		2() · · · ·
PCB 1260	·	20
Total PCBs		2()
TOTAL LCDS		-11

#### TABLE 1 (Cont'd)

# TARGET DETECTION LIMITS (as Dry Weight)

Constituent	Method	Sediment
PAHs (μg/kg) Cleanup methods	8270C 3611/3630	
Naphthalene	5011/3030	2()
Acenaphthylene		20
Acenaphthene		20
Fluorene		20
Phenanthrene		20
Anthracene		20
Fluoranthene		20
Pyrene		20
Chrysene		20
Benzo (A) Anthracene		20
Benzo (K) Fluoranthene		20
Benzo (B) Fluoranthene	•	20
Benzo (A) Pyrene		20
Ideno (1,2,3-CD) Pyrene		20
Dibenzo (A,H) Anthracene		20
Benzo (G,H,I) Perylene	•	20
Total PAHs		20
Organotin (μg/kg)	GC/MS	
Monobutyltin		
Dibutyltin		
Tributyltin	•	į.
Tetrabutyltin		1
Total Solids (%)	Plumb (1981)	(). 1
TOC (%)	Plumb (1981)	(), (
100 (70)	riumo (1901)	(7, 1

#### Table 2

### Summary of Test Conditions and Acceptability Criteria for the Mussel (Mytilus sp.) and the Oyster (Crassostrea sp.), Acute Toxicity Water Column Test

		•
1.	Test type	Static non-renewal
2.	Test duration	48 Hours
3.	Temperature	16 ± 2° C
4.	Salinity	24 - 35 ppt
5.	Light quality	Ambient Laboratory
6.	Light intensity	50-100 ft c.
7.	Photoperiod	16L/8D
8.	Test chamber size	150 mL flask
9.	Test solution Volume`	100 mL
10.	Renewal of seawater	None ·
11.	Age of test organisms	Embryo ≤ 4h old
12.	Number of organisms per test chamber	1500- 3000
13.	Number of replicate chambers/concentration	· 5
14.	Number of organisms per concentration	7500-15.000
15.	Feeding regime	None
16.	Test chamber cleaning	Lab washing prior to test
17.	Test solution aeration	None
18.	Elutriate dilution water	Dredge site water
19.	Test concentrations	Test sites, reference site and
		control
20.	Dilution series	Four concentrations (1, 10, 50.
	(	100%)
21	Dilution water	Natural seawater
22	Endpoints	Survival % and abnormal
	•	development
22.	Sample and sample holding requirements	< 8 weeks
23.	Sample volume required	2 L
24.	Test acceptability criteria	≥ 70% survival and normal
	•	development in the controls.
		<10% abnormal in control
25.	Reference toxicant results	Within 2 SD of laboratory mean

Reference: ASTM. 1998a. Method E724-94. Standard Guide for conducting static acute toxicity tests with starting with embryos of four species of seawater bivalve mollusk. Annual Book of ASTM Standards, Vol 11.05. American Society for Testing and Materials. Philadelphia, Pa.

#### Table 3

#### Summary of Test Conditions and Acceptability Criteria for the Sea Urchin, Strongylocentrotus purparatus (1), Acute Toxicity Water Column Test

1.	Test type	Static non-renewal
2.	Test duration	48-96 hours
3.	Temperature	14 ± 2° C
4.	Salinity	30 - 32 ppt
5.	Light quality	Ambient Laboratory
6.	Light intensity	50-100 ft c.
7.	Photoperiod	14L/10D
8.	Test chamber size	125 mL flask
9.	Test solution Volume`	100 mL
10.	Renewal of seawater	None
11.	Age of test organisms	Embryo ≤4h old
12.	Number of organisms per test chamber	2,000-3000
13.	Number of replicate chambers/concentration	3
14.	Number of organisms per concentration	6,000 - 9,000
15.	Feeding regime	None
16.	Test chamber cleaning	Lab washing prior to test
17.	Test solution aeration	None
18.	Elutriate dilution water	Dredge site water
19.	Test materials	Test sites, reference and control
20.	Dilution series	1, 10, 50, 100% elutriate
21	Dilution water	Natural seawater
22	Endpoints	Normal survival percentage
22.	Sample and sample holding requirements	< 8 weeks
23.	Sample volume required	2 L
24.	Test acceptability criteria	≥ 70% survival and normal
	-	development in the controls
25.	Reference toxicant results	Within 2 SD of laboratory mean

Reference: ASTM. 1998a. Method E1563-95. Standard Guide for conducting static acute toxicity tests with echinoid embryos. Annual Book of ASTM Standards. Vol 11.05. American Society for Testing and Materials, Philadelphia, Pa.

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Note: Lytechinus is an acceptable substitute.

#### Table 4

# **Summary of Test Conditions and Acceptability Criteria for the Amphipod, Ampelisca abdita, Acute Toxicity Sediment Test**

1.	Test type	Static non-renewal
2.	Test duration	10d
3.	Temperature	$20 \pm 2^{\circ} C$
4.	Salinity	20 - 35 ppt
5.	Light quality	Ambient Laboratory
6.	Light intensity	50-100 ft c.
7.	Photoperiod	Continuous
8.	Test chamber size	, IL
9.	Seawater Volume`	850 mL
10.	Sediment depth	40 mm
11.	Renewal of seawater	None
12.	Age of test organisms	Wild population, immature
		juveniles
13.	Number of organisms per test chamber	20
14.	Number of replicate chambers/concentration	5
15.	Number of organisms per sediment type	100
16.	Feeding regime	None
17.	Test chamber cleaning	Lab washing prior to test
18.	Test solution aeration	Low bubble (~100/minute)
19.	Overlying water	Natural seawater
20.	Test materials	Test sites, reference and control
21.	Dilution series	None .
22	Endpoint	Mortality
23.	Sample and sample holding requirements	< 8 weeks
24.	Sample volume required	2 L
25.	Test acceptability criteria	$\geq 90\%$ in the controls
26.	Reference toxicant results	Within 2 SD of laboratory mean

Reference: ASTM. 1998b. Method 1367-92. Standard Guide for conducting 10 day static toxicity tests with marine and estuarine amphipods. Annual Book of ASTM Standards, Vol 11.05. American Society for Testing and Materials, Philadelphia, Pa.

#### Table 5

# Summary of Test Conditions and Acceptability Criteria for the Marine Polychaete, Nephtys caecoides, Acute Toxicity Sediment Test

1.	Test type	Static, renewal
2.	Test Duration	10d
3.	Temperature	15 ± 2° C
4.	Salinity	30 - 35 ppt
5. ·	Light quality	Ambient Laboratory
6.	Light intensity	50-100 ft c.
7.	Photoperiod	14L/10D
8.	Test chamber size	5 L polypropylene chambers
9.	Test solution volume`	3.5 L
10.	Sediment depth	45 mm
11.	Renewal of seawater	80% at 48 hour intervals
12.	Age of test organisms	Wild population juveniles
13.	Number of organisms per test chamber	10
14.	Number of replicate chambers/concentration	5
15.	Number of organisms per sediment type	50
16.	Feeding regime	None
17.	Test chamber cleaning	Lab washing prior to test
18.	Test solution aeration	Low bubble (~100/minute)
19.	Overlying water	Natural seawater
20.	Test concentrations	Test sites, reference and control
21.	Dilution series	None
22	Endpoint	Mortality
23.	Sample and sample holding requirements	< 8 weeks
24.	Sample volume required	10 L
25.	Test acceptability criteria	$\geq 90\%$ in the controls
26.	Reference toxicant results	Within 2 SD of laboratory mean

References: ASTM 1998c. Method E1611-94. Standard guide for conducting sediment tests with marine and estuarine polychaetous annelids. Vol 11.05. American Society for Testing and Materials, Philadelphia, Pa.

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Note 1

The coordinates for the Environs stations are as follows:

Station	Latitude (North)	Longitude (West)
Station A	37° 49.75'	122° 25.88'
Station B	37° 49 75'	122° 25.57'
Station C	37° 49.75'	122° 24.90`
Station D	37° 49.27'	122° 25.88'
Station F	37° 49.27'	122° 24,90°
Station G	37° 48.83'	122° 25.88°
Station H	37° 48.83 '	122° 25.57`
Station I	37° 48.83'	122° 24.90)